Fermilab

Directorate

MEMORANDUM OF UNDERSTANDING
FOR THE 2002-3 MESON TEST BEAM PROGRAM

T931

BTeV Muon Detector Test Beam Run

November 5, 2002

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Introduction

E918 (BTeV) is an approved experiment. It requires detector research and development in tracking, triggering, data acquisition, charged hadron identification, electromagnetic calorimetry and muon detection, as well as an extensive effort in simulation and software development. The goal of the present R&D project is to develop the final devices for use in the BTeV experiment. This MOU relates to muon detector tests which will be carried out using the MTEST beam of the Meson Area during the 2002-2003 run period.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and those experimenters of E918 who have committed to participate in muon beam tests to be carried out during the 2002-2003 period. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum that will reflect such required adjustments.

I. Personnel and Institutions

BTeV Muon Test Beam Spokesperson:	Will Johns, Vanderbilt University
Physicist in Charge:	Will Johns, Vanderbilt University
E918 Test Beam Liaison:	Charles Newsom, University of Iowa
E918 Computing Off-line liaison:	Will Johns, Vanderbilt University
E918 Computing On-line liaison:	Will Johns, Vanderbilt University
Fermilab liaison physicist:	Erik Ramberg
Beamline physicist:	From Beams Div./External Beams Dept. Currently, Tom Kobilarcik
Particle Physics Division Liaison:	Erik Ramberg
Computing Division Liaison:	Dave Slimmer

The Collaboration members at present are

1.1 University of Illinois – Urbana-Champaign: J. Wiss, D. Kim
1.2 University of Puerto Rico – Mayaguez: A. Lopez, Z. Li
1.3 Vanderbilt University: W. Johns, P. Sheldon, M. Webster, E. Vaandering

Other commitments:

FNAL E831/FOCUS analysis: J. Wiss, D. Kim, A. Lopez, Z. Li, W. Johns, P. Sheldon, M. Webster, E. Vaandering

II. Experimental Area, Beams, and Schedule Considerations

2.1 LOCATION AND FACILITIES

2.1.1 The test apparatus is to be located in the downstream open area (MT6B) in the MTEST beam line. Approximately 10 feet along the beam direction are required. In addition, the test-beam Control/Counting Room to the west of the MTEST beam will be used to house electronics.

2.1.2 A “gateway” computer with Internet access should be provided. Powered racks for electronics and NIM bins should also be made generally available.

2.1.3 Space in cable trays for approximately 20 cables (20 high voltage and 20 ribbon cables connecting the MT6B to the Counting Room) are required.

2.1.4 Space in electronics racks is needed in MT6B and the Counting Room. We require 30 inches of space in each area.

2.1.5 One standard-size table will be required in the test-beam Counting Room. Computer networking to the gateway computer will be required at the table.

2.1.6 The power requirements are 2 KW of clean power for electronics.

2.2 BEAM

2.2.1 The tests will use slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The tests require a beam of untagged, charged particles of momentum 10 GeV/c or higher. We will also require a significant muon-only flux, which can be achieved by inserting the beam stop between MT6A and MT6B.

2.2.2 Intensity: Variable, in the range of 1-100 kHz per square cm. We require at least some intensity above 10 kHz/cm^2.

2.3 SCHEDULE

The goal is to deliver charged particles at the rate stated above for data taking as required by the R&D program over a significant period beginning in November, 2002. The group expects to run sporadically for about 3 months. The group expects to share beam time with other R&D efforts. Details are given in the section below labeled Run Plan.

III. Responsibilities by Collaboration Physics Group

([] denotes replacement cost of existing hardware.)

3.1 University of Puerto Rico - Mayaguez

University of Puerto Rico – Mayaguez physicists will participate in the preparation and data taking phases of the test beam run.

3.1.1 Travel for personnel: $ 4 K

Total existing items	**[0]**
Total new equipment items	**0**
Total operating cost	**$4 K**

3.2 University of Illinois – Urbana-Champaign

University of Illinois – Urbana-Champaign physicists will participate in the preparation and data taking phases of the test beam run.

3.2.1	Gas (3 large bottles Argon, 1 large bottle CO_2, and 1 small bottle of CF_4).	$ 0.3 K
3.2.1	Travel for personnel:	$ 1.3 K

Total existing items	**[0]**
Total new equipment items	**$ 0.0 K**
Total operating cost	**$ 1.6 K**

3.3 Vanderbilt University

Vanderbilt University physicists will participate in the preparation and data taking phases of the test beam run.

3.3.1	Computer for data readout and analysis	[$ 2 K]
3.3.2	CAMAC controller card	[$ 2 K]
3.3.3	Muon planks	[$ 10 K]
3.3.4	Transportation of muon detectors from Vanderbilt to Fermilab	$ 1 K
3.3.5	Travel for personnel:	$ 4 K

Total existing items	**[$ 14 K]**
Total new equipment items	**0**
Total operating cost	**$ 5 K**

3.S Summaries of Section 3

3.S.1 Summary of Collaboration Responsibilities

Test beam coordination – Vanderbilt

Mechanical support – Vanderbilt

Trigger – Vanderbilt, Illinois, Puerto Rico

Data Acquisition – Vanderbilt

Monitoring and Event Display – Illinois

Offline Software (including data bases, run log, and web: development, maintenance) – Vanderbilt, Illinois, Puerto Rico

3.S.2 Summary of Non-Fermilab Costs

	Equipment	Operating
Total existing items	**[$ 14 K]**	
Total new items	**$ 0.0 K**	**$ 10.6 K**

IV. Responsibilities by Fermilab Division

([] denotes replacement cost of existing hardware.)

4.1 Fermilab Beams Division

4.1.1 Use of MTest beam line.

4.1.2 Maintenance of all existing standard beam-line elements (such as SWICs, loss monitors, remotely-controlled finger counters, etc), instrumentation, controls, clock distribution and power supplies.

4.1.3 Reasonably rapid access to our equipment in the test beam. Such access is anticipated to be less than once per hour, typically more like once per shift.

4.1.4 Logic signal at experimenter electronics racks that has a constant phase (within 1-2 ns in a given hour) with respect to the arrival of beam buckets at the test apparatus.

4.1.5 No experiment-owned devices need interfacing to the Beams Division control system, other than the possible readout of beam-line variables.

4.1.6 Position and focus of the beam on the experimental devices under test will be under control of the BD Operations Department (MCR). Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.

4.1.7 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.1.S Summary of Beams Division costs:

	Equipment	**Operating**	**Personnel (person-weeks)**
Total new items	$ 0 K	$ 0 K	0
Total	$ 0 K	$ 0 K	0

4.2 Fermilab Particle Physics Division

The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including any use of allowed user beam-line controls, readout of the beam-line detectors, and operation of the MTest gateway computer.

4.2.1 Use of the gateway UNIX computer for interfacing and isolation of DA computers.
4.2.2 Installation of quiet power (see Section 2.1.6) to detector enclosure if required to reduce noise in electronics. Provision of adequate air-conditioning and cooling for detectors and electronics in the beam area, the electronics alcove, and the counting room.
4.2.3 Provision of adequate moisture protection for equipment and personnel in MTest beam area and counting room.

4.2.S Summary of Particle Physics Division costs:

	Equipment	**Operating**	**Personnel (person-weeks)**
Total existing items	**$ 0 K**		
Total new items	**$ 0 K**	**$ 0 K**	**0**
Totals	**$ 0 K**	**$ 0 K**	**0**

4.3 Fermilab Computing Division

4.3.1 The Liaison from the Computing Division is Dave Slimmer.
4.3.2 The experimenters from Vanderbilt, Illinois, and Puerto Rico will write all necessary offline software. Most of this work has already been performed for the last beam test in the summer of 1999.
4.3.3 The experimenters will reuse data acquisition code from the summer, 1999 beam test. The experimenters plan to supply their own computer and CAMAC controller to read out the muon detector.
4.3.4 Computer security for the pixel system in MTest will be organized by having wide-area networking for the DA computers through the Meson Test Facility gateway computer and via kerberized systems more directly attached to the networking backbone.
4.3.5 Support of the networking in MTest, including access to a gateway computer and local networking between the gateway and DA computer(s) which will not have network access.
4.3.6 PREP equipment. Vanderbilt currently has PREP equipment obtained by means of an offsite loan for the purpose of preparing and running in a test beam. This equipment will be transported to Fermilab and used in the test beam. Appendix 1 contains a list of currently checked out items. The estimated value of this equipment is [$ 50 K].

4.3.7 Maintenance and repair of the PREP equipment we have checked out is estimated to cost $ 1 K.

4.3.S Summary of Computing Division Costs:

Type of Funds	**Equipment**	**Operating**	**Personnel (person-weeks)**
Total existing items	[$ 50 K]		
Total new items	$0 K	$1 K	0
Totals	**$50 K**	**$1 K**	**0**

4.S Summary of Fermilab costs

Type of Funds [] denotes existing	**Equipment**	**Operating**	**Personnel** (person-weeks)
Beams Division	0	0	0
Particle Physics Division	0	0	0
Computing Division	[$ 50 K]	$1 K	0
Total existing items	**[$ 50 K]**	**0**	**0**
Total new items	**$0 K**	**$1 K**	**0**

V. Special Considerations

5.1 The responsibilities of the BTeV Muon Test Beam Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Scientific Spokesperson agrees to those responsibilities and to follow the described procedures.

5.2 To carry out the experiment, a number of Environment, Safety and Health (ES&H) reviews are necessary. The procedures to carry out these various reviews, including a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee, are found in the Fermilab publication "Review Procedures for Experiments" (RPX). The BTeV Muon Test Beam Spokesperson undertakes to follow those procedures in a timely manner.

5.3 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

5.4 All items in the Fermilab Policy on Computing will be followed by experimenters.

5.5 At the time of purchasing, the Fermilab procurement policies shall apply.

5.6 For the purpose of estimating budgets, specific products and vendors may be mentioned within this memorandum. At the time of purchasing, the Fermilab procurement policies shall apply. This may result in the purchase of different products and/or from different vendors.

5.7 The BTeV Muon Test Beam Spokesperson will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered.

5.8 The BTeV Muon Test Beam Spokesperson will undertake to ensure that no PREP and computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

5.9 Each institution will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

5.10 If the experiment brings to Fermilab on-line data acquisition or data communications equipment to be integrated with Fermilab owned equipment, early consultation with the Computing Division is advised.

5.11 At the completion of the experiment:

5.11.1 The BTeV Muon Test Beam Spokesperson is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the BTeV Muon Test Beam Spokesperson will be required to furnish, in writing, an explanation for any non-return.

5.11.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

5.11.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

5.11.4 An experimenter will report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

____________________________________ / / 2002
Will Johns, BTeV Muon Test Beam Spokesperson

____________________________________ / / 2002
John Cooper, Particle Physics Division

____________________________________ / / 2002
Roger Dixon, Beams Division

____________________________________ / / 2002
Vicky White, Computing Division

____________________________________ / / 2002
William Griffing, ES&H Section

____________________________________ / /2002
Hugh Montgomery, Associate Director for Research, Fermilab

____________________________________ / /2002
Steven Holmes, Associate Director for Accelerators, Fermilab

____________________________________ / / 2002
Michael Witherell, Director, Fermilab

____________________________________ / / 2002
Joel Butler, BTeV Co-spokesperson

____________________________________ / / 2002
Sheldon Stone, BTeV Co-spokesperson

APPENDIX I – PREP Equipment List

(NOTE: This equipment has already been checked out for an offsite loan to Vanderbilt University (Fermilab loan C565).)

Prop#	Ser#	Model	Description
061416	7126	DSP: 860C	CRATE,CAMAC
063826	7447	DSP: 860C	CRATE,CAMAC
513556	7126	DSP: 860F	FAN,CRATE,CAMAC
516361	8003	DSP: 860F	FAN,CRATE,CAMAC
516734	8055	DSP: 860F	FAN,CRATE,CAMAC
512327	6855	DSP: 860P	POWER SUPPLY,CAMAC,6@50;1
513426	7045	DSP: 860P	POWER SUPPLY,CAMAC,6@50;1
513566	7126	DSP: 860P	POWER SUPPLY,CAMAC,6@50;1
502608	22174	FERMI: 029029	FAN,CRATE,NIM
509989	---	FERMI: 2107	FAN,CRATE,NIM
510522	---	FERMI: 2107	FAN,CRATE,NIM
018764	---	FERMI: ES-7092	DIVIDER,HIGH VOLTAGE
003075	2613	FLUKE: 415B	POWER SUPPLY,HV,3KV@30MA
052568	197	JOERGER: GG	GENERATOR,GATE,2CH,NON-UP
068902	210	JOERGER: GG	GENERATOR,GATE,2CH,NON-UP
069598	229	JOERGER: GG	GENERATOR,GATE,2CH,NON-UP
023479	269	JORWAY: 1880B	SCALER,2CH,VISUAL,NIM
050075	365	JORWAY: 1880B	SCALER,2CH,VISUAL,NIM
018213	142	JORWAY: 1883	SCALER,PRESET,8 DIGIT,100
018216	143	JORWAY: 1883	SCALER,PRESET,8 DIGIT,100
561714	478	JORWAY: 73A	CONTROLLER,CRATE,CAMAC,SC
561719	473	JORWAY: 73A	CONTROLLER,CRATE,CAMAC,SC
036792	60539	LRS: 2551-48	SCALER,6 CH,48B,100MHZ,CA
062006	A51700	LRS: 2551-48	SCALER,6 CH,48B,100MHZ,CA
540547	B37342	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540608	B37384	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540610	B37351	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540640	B37464	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540717	B37371	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540719	B37406	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
540788	B36652	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
544763	B49191	LRS: 3377	TDC,32CH,16B,MULTIHIT,CAM
019611	15410	LRS: 364ALP	LOGIC,2CH,4-FOLD,MAJORITY
020225	17074	LRS: 364ALP	LOGIC,2CH,4-FOLD,MAJORITY
020231	17072	LRS: 364ALP	LOGIC,2CH,4-FOLD,MAJORITY
020237	17053	LRS: 364ALP	LOGIC,2CH,4-FOLD,MAJORITY
047197	81628	LRS: 4416B	DISCRIMINATOR,16CH,CAMAC
047200	81629	LRS: 4416B	DISCRIMINATOR,16CH,CAMAC
036588	03675	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
052596	82343	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
062773	A36185	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
065190	A68408	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
065196	A68406	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
065200	A68391	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
065212	A68377	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
066608	A68386	LRS: 4418/32	DELAY,FAN-OUT,16CH,ECL,32
055251	83589	LRS: 4616	CONVERTER,16CH,ECL/NIM/EC
062795	32693	LRS: 4616	CONVERTER,16CH,ECL/NIM/EC
072667	B01306	LRS: 4616	CONVERTER,16CH,ECL/NIM/EC
021846	17718	LRS: 621BL	DISCRIMINATOR,4CH,110MHZ,
021861	17682	LRS: 621BL	DISCRIMINATOR,4CH,110MHZ,
025517	27924	LRS: 621BL	DISCRIMINATOR,4CH,110MHZ,

050914	844003	MECHTRON: 3034	BIN,NIM
056743	862013	MECHTRON: 3034	BIN,NIM
513710	---	MECHTRON: 3034	BIN,NIM
502188	00003	NUC SPEC: 05235-RB	FAN,CRATE,NIM
026019	13182	ORTEC: 401A	BIN,NIM
505086	102024	PD: AEC-320-9	POWER SUPPLY,6@10A,12@3A,
505098	102015	PD: AEC-320-9	POWER SUPPLY,6@10A,12@3A,
506744	308211	PD: AEC-320-9	POWER SUPPLY,6@10A,12@3A,
509015	501004	PD: AEC-320-9	POWER SUPPLY,6@10A,12@3A,
036973	3502	SEC: 850C	CRATE,CAMAC
030652	334	VK: 6900	POWER SUPPLY,HV,2CH,POSIT
032896	483	VK: 6900	POWER SUPPLY,HV,2CH,POSIT
035040	491	VK: 6900	POWER SUPPLY,HV,2CH,POSIT
046919	729	VK: 6900	POWER SUPPLY,HV,2CH,POSIT
544324	1186	VK: 6900	POWER SUPPLY,HV,2CH,POSIT

APPENDIX II – Offline Analysis Plan

DATA PROJECTION

Based on the run plan outlined on page in Appendix III, we expect at most a few tens of gigabytes of data. This will be stored on the DAQ computer through the lifetime of the test beam run. It will also be copied to computers located at the three participating institutions, Vanderbilt, Illinois, and Puerto Rico.

ANALYSIS PLAN

Analysis will be performed using computing facilities available at the three collaborating institutions. Analysis computing will not be a problem.

REQUEST

No offline computing resources are requested from Fermilab. .

APPENDIX III - Run Plan

We will construct a working system at Vanderbilt University using cosmic rays. All of the equipment necessary is already available at Vanderbilt University as a result of the offsite loan obtained from PREP. Thus, once the MTest beam is stable we will be able to transport and install the entire muon detector and readout system in a couple of days.

Run Plans:

1. Goals:
   The main goal of this beam test is to check that the current muon design will work in a real world environment. Other goals including checking rate limitations, various gas mixtures, and time resolution. We require about 2 months of calendar time for a beam which is available 50% of the time. Less available beam will extend this time but more beam will not reduce it.
2. Specific plans:
   a. We will first test the muon detector in a standard moderate rate beam to check tube efficiency, random noise, and correlated noise.
   b. We will conduct some high rate tests of the detector. We would like to test the detector with rates as high as 100 kHz/cm^2, if possible. This is about 30 times the maximum rate expected in the detectors in the BTeV environment.
   c. We will measure the gain, efficiency, plateau window, and time resolution of a variety of gas mixtures. We would like to study various mixtures of $Ar{:}CO_2$ and $Ar{:}CO_2{:}CF_4$.
   d. We will also use the collected data to determine if TDCs would be useful in rejecting background or improving resolution as opposed to a simple binary signal within the accelerator clock window.

APPENDIX IV - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		**Electrical Equipment**		**Hazardous/Toxic Materials**	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		capacitor banks		planned for use in a beam line or
	Target		high voltage (> 5 kV)		experimental enclosure:
	Bubble chamber		exposed equipment over 50 V		
Pressure Vessels		**Flammable Gasses or Liquids**			
	inside diameter	type:			
	operating pressure	flow rate:			
	Window material	capacity:			
	Window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter		temporary use		Beryllium (Be)
	operating pressure	type:	Fe55, Sr90,Ru		Lithium (Li)
	window material	strength:			Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other : Probably C/Al/Cu/Si
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		lifting devices
type:	Nitrogen		TEA		motion controllers
Wattage:			photographic developers		scaffolding/elevated platforms
class:	III	X	Other: Freon 14		Others